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GERMINATION AND GROWTH PERFORMANCE OF RUBBER SEEDLINGS (HEVEA BRASILIENSIS MUELL) IN RESPONSE TO GROWING MEDIA AND DIFFERENT RATES OF GIBBERELLIC ACID (GA3)

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ABSTRACT

A study investigated rubber seedling's germination and growth performance in response to growing media and gibberellic acid (GA3) rates. This study was laid out in 4 x 3 factorial arrangements in Completely Randomized Design (CRD) with four growing media as Factor A and three levels of GA3 as Factor B. All treatments were replicated three times. Results revealed that rubber seeds placed in garden soil + vermicast media mixture significantly exhibited the earliest seed germination of 10.78 days, significantly different from the rest of the treatments. This medium significantly gave the highest germination (84.44%), developed the tallest plants (59.94 cm) with the most number of leaves (12.86) and longest roots (8.32 cm). Seedlings from this media also developed the biggest stem diameter (2.80 mm) and 100 percent normal seedlings. However, seedlings were grown in garden soil mixed with rice hull statistically exhibited the most number of roots (10.89) per seedling. Application of GA3 at 100 ppm significantly enhanced the earliest seed germination of 12.25 days and highest germination (78.33%), produced the tallest plants (59.64 cm) gave the most number of leaves per plant (12.05). This treatment also exhibited the most number of roots (10.59) and stemmed diameter (1.69 cm) comparable to those treated with 50 ppm GA3. Likewise, the application of 100 ppm GA3 significantly gave the highest percentage of normal seedlings (93.75%).

INTRODUCTION

Rubber (*Hevea brasiliensis* Muell) is an economically important perennial plant whose sap-like extract known as 'latex,' or native rubber is the major product with varied industrial, technological, and domestic uses. The unique technical properties of natural rubber have made it most suitable for various purposes than synthetic rubber.

Rubber production is one of the most profitable agri-industrial ventures in the country. The Philippines' natural rubber industry prospects can be gauged by the domestic and export market requirements (CARRDEC, 2007). Likewise, with the continuous and increasing rubber price in the world market and the great potential areas suitable for rubber in the Philippines, particularly Tawi-Tawi, farmers are encouraged to plant rubber trees. One of the limitations in the expansion for rubber production is the lack of planting materials, especially with the conversion of vast areas in Tawi-Tawi suitable for farming this crop.

The choice for rubber as the best tree crop is for its economic importance, but this is also aligned with the current reforestation, environmental conservation, and water management programs of our government in addressing the local and global issues and concerns regarding climate change agriculture production.

This is evident with the Department of Agriculture's move of identifying rubber as one of the top priority commodities. Aside from generating employment in the rural areas, the planting of rubber in idle hilly lands and uplands enhances environmental rehabilitation, being a good plant species in the sequestration of carbon dioxide (SMIARC Technoguide, 2007).

Rubber is generally propagated by seed or by vegetative or clonal reproduction. Seeds are grown for rootstock purposes. However, seeds do not germinate at the same time. These are gathered and accumulated first to reach a particular target quantity before planting. Hence in many cases, seeds lose their viability since rubber seeds are recalcitrant.

It was reported that gibberellic acid could enhance seeds' germination (Hartman and Kester, 2000). At present, limited studies and information are available on the appropriate growing media and GA_3, and nutrient application on the germination, seedling growth rubber seedling, hence this study.

Objectives of the study

This study was generally conducted to determine the effects of growing media and gibberellic acid on seed germination and rubber seedlings' growth performance.

Specifically, this study aimed to:

1. Compare the seed germination and seedling growth of rubber grown in the different media;
2. Determine the percentage seed germination and seedling growth of rubber in response to rates of GA3; and
3. Identify the growing media and level of GA_3 that will enhance seed germination and rapid seedling growth of rubber.

Review of literature

To provide clarity, related studies and some other information were hereunder presented.

The rubber tree is a perennial crop that belongs to the Euphorbiaceae family. A native of Brazil possesses the high yielding potential and genetic variability. Rubber tree fruit mature with a dehiscent capsule usually containing three seeds, and dry fruits opening occur during late summer. Seeds of rubber complete its germination from 10 to 15 after sowing and produce hypogeal seedlings. Rubber seed is a recalcitrant that undergo no maturation as the final stage of its development. Such a kind of seed can only tolerate very little post-shedding desiccation and chilling-sensitive. Opposite to this is orthodox seeds that are shed from the mother plant with low moisture contents, and their storability is favored for drying and decreased temperature. (Civero et al., 1986). Germination of rubber seeds (RRIM 600) collected during the peak seed fall germinated earlier before 14 days from sowing with more vigorous growth, which reached the buddable stem girth two months after planting. While those seeds gathered during its early seed fall had very low percentage germination (Alcala (2007)

According to Neelam and Ishtiaq (2001), soil media play a key role in enhancing soil physical and chemical properties, thereby increasing the penetrating capacity of roots in media. Moreover, when the medium offered a suitable environment with proper aeration, sufficient water, nutrient availability, and an excellent roots system developed, plants' luxurious growth resulted.

Gibberellic Acid is a naturally occurring plant hormone that triggers the germination of seeds by helping them sprout. By manipulating the level of Gibberellic Acid seeds exposed, farmers can better control when their crops grow. As a result, farmers can gauge better when to harvest their crops. According to Mumatz et al. (2003), the seeds of Kharna Khatta treated with GA3 gave maximum mean germination (100%) when seeds soaked in 35 and 60 ppm GA3 for 24 hours to seeds dipped in distilled water and 40 ppm GA_3. At the same time, those seeds of bittersweet orange indicated the highest germination percentage when treated with 35 and 40 ppm GA_3. However, in the case of Savage Centrange considerable increase in the rate (96%) was observed in those seeds applied with 35 ppm concentration of GA3 for 24 hours. Other effects of GA_3 were also significantly noted in seeds of Sacatan citrumelo gave 95% germination. These results indicated that all seeds were treated with 35 to 60 ppm of GA_3 concentration for 24 hours had significantly increased the percentage germination.

According to Castillos (2009), rice hull, manure compost, and vermicompost will enhance soil fertility and provide organic matter to the soil. Compost rice hull is useful in boosting nutrients that gradually become soil organic matter, providing a source of nutrients for the long-term that will soften the soil hardness. It will give better soil conditions for root growth and improved soil capacity for plant growth. Likewise, the highest seedling growth attributes were obtained from the media prepared by adding 10% rice hulls to the peat material. Aeration porosity and usable water amount as its volume was 60.1% and 15.9%, respectively (Aklibasinda et al., 2011).

According to Radovich et al. (2009), the vermicompost, which was adequately produced, has several advantages as a seedling medium. It has relatively high nitrate, which can enhance seedling germination and stimulate seedling growth. It has a high microbial activity that may protect the seedlings from pests and have little or no phytotoxicity. Vermicomposts have been considered a soil additive to reduce mineral fertilizers because they provide required nutrients, increase cation exchange capacity, and improve water holding capacity. However, each vermicompost's effect on soil properties and crop yield depends on its chemical composition (Tejada and Gonzalez, 2009).

A study conducted at the University of Southern Mindanao on germination and seedling performance of Marang sown in different media results indicates that garden soil mixed with compost in equal ratio produced the highest percentage of germination, leaf counts, taller and bigger stem girth of marang compared to ordinary garden soil (Amilbahar 1987).

MATERIALS AND METHODS

This part presents the research design, collection and preparation of materials, preparation of the treatments, data gathering, statistical treatment of the data, and experimental area preparation.

Experimental design and treatments

The experiment was carried out in 4x3 factorial arrangements in Complete Randomized Design (CRD). Factor A consisted of four growing media which are: Garden Soil as control, Vermicast + Garden Soil, Chicken dung + Garden Soil, Rice hull + Garden soil (a mixture of garden soil and organic nutrients in 50: 50 ratio), while the three levels of Gibberellins: 0 ppm (control), 50 ppm and 100 ppm served as Factor B. All treatment combinations were replicated three times with 30 seeds per replication per treatment.

Preparation of germination beds

Three germination beds were constructed by the space needed for the purpose, with a dimension of 150 x 600 cm and 30 cm of pathways to give ample space to grow the rootstocks and seedlings, some space for piling soil media and maintenance of the nursery. Germination beds were cleaned correctly and pulverized to ensure the uniform arrangement of all seeds. Shade using fishnet was established to protect the newly germinated seedlings from direct sunlight, heavy rain, and wind. The germination beds were also maintained and cleaned to avoid pests and diseases.

Preparation of growing media

The corresponding growing media were sieved using a wire mesh to ensure greater homogeneity, and undesirable materials were screened. After thorough sieving and cleaning, the media were mixed carefully by following the appropriate ratio and proportion. Each growing media treatment was prepared and labeled as garden soil, garden soil plus chicken dung, garden soil mixed with rice hull, and garden soil combined with vermicast in equal amounts of 50:50 ratio.

Gibberellic acid treatment on rubber seeds

Gibberellic Acid of 50 ppm and 100 ppm concentrations were prepared from a 5,000 ppm stock solution. This was diluted using the $C_1 V_1 = C_2 V_2$ method to obtain the desired concentration treatments. All seeds were standardized using only those seeds of similar size, shell color, and well-formed shapes. Seeds were soaked overnight in gibberellic acid according to their corresponding level treatments before sowing.

Care and management practices

Watering, weeding, and pest and disease management was done regularly or as necessary with more or less water to prevent the soil media from drying and compacting and ease removing the weeds. Prevention of pests and diseases on the newly germinated seedlings were also observed.

Data gathering

Percent Germination, Number of Days to Seed Germination, Height of Seedlings, Number of Leaves, Stem Diameter, Number of Roots, and Length of Roots were collected properly collected according to treatment and replication. After which, they were recorded adequately according to the arrangement of the statistical design.

Statistical analysis

Data gathered were subjected to Analysis of Variance (ANOVA) in Factorial Arrangement in Completely Randomized Design (CRD). Significant differences among treatment means were compared using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Number of days to seed germination

Table 1 presents the number of days to seed germination of rubber in response to growing media and gibberellic acid (GA_3). Findings showed that the number of days to seed germination of rubber was highly affected by growing media and gibberellic acid application rates. However, no significant interaction effects between these two factors were observed.

Results revealed that rubber seeds sown in garden soil combined with vermicast significantly germinated the earliest at an average of 10.78 days compared to those in garden soil mixed with either rice hull or chicken dung had comparable seed germination of 12.44 and 13.11 days, respectively. However, seeds that were sown in garden soil alone (control) had significantly delayed germination of 15.88 days, which differed from all the treatments.

Application of GA_3 differed among treatments. Rubber seeds applied with 100 ppm GA_3 germinated early (112.25 days) followed by those applied with 50 ppm (13.08 days) than the control regardless of soil media.

Table 1: Number of days to seed germination of rubber in response to growing media and rates of gibberellin

Growing Media	**Rates of Gibberellin (ppm)**			**Mean**
	0	**50**	**100**	
Garden Soil	17.33	16.00	14.33	15.88^{a}
Garden Soil + Chicken Dung	13.67	13.33	12.33	13.11^{b}
Garden Soil + Rice Hull	13.00	12.33	12.00	12.44^{b}
Garden Soil + Vermicast	11.33	10.67	10.33	10.78^{c}
Mean	13.83^{a}	13.08^{b}	12.25^{c}	

Note: CV = 6.25%

Means within the same column and row followed by a common letter are not significantly different at 5% level DMRT.

Percent germination

The percentage germination of rubber seeds is given in Table 2. Results revealed that growing media and levels of GA_3 highly affected the percent germination of rubber seeds. Seeds sown in garden soil mixed with vermicast had the highest seed germination (84.44%), followed by those in garden soil in combination with either chicken dung (75.56%) or rice hull (68.15%), which were statistically similar. The control gave the lowest percentage germination of 54.69% only.

Seeds applied with 100 ppm GA_3 significantly had the highest germination of 78.33%, which differed from those treated with 50 ppm 71.11%, and the untreated seeds had the least with 62.69% only.

Table 2: Percent germination (%) of rubber seeds as influenced by growing media and rates of gibberellin

Growing Media	Rates of Gibberellin (ppm)			Mean
	0	50	100	
Garden Soil	47.40	53.33	63.33	54.69[c]
Garden Soil + Chicken Dung	70.00	73.33	83.33	75.56[b]
Garden Soil + Rice Hull	60.00	71.11	73.33	68.15[b]
Garden Soil + Vermicast	73.33	86.67	93.33	84.44[a]
Mean	62.69[c]	71.11[b]	78.33[a]	

Note: CV = 11.12%

Means within the same column and row followed by a common letter are not significantly different at 5% level DMRT.

Stem diameter of seedlings

The stem diameter of rubber seedlings at 30, 45, and 60 days after sowing is reflected in Table 3. At 30 DAS, this parameter was highly influenced by the growing media and gibberellin application rates their interactions.

Among the growing media, at 30 DAS, garden soil – vermicast mixture induced seedlings' development with the biggest diameter of 1.35 mm, which differed from the rest of the growing media. Those followed this in garden soil + rice hull with 1.25 mm stem diameter of seedlings which differed from those grown in garden soil + chicken dung which has the smallest stem diameter of 1.15 compared to that of the control of 1.18 mm.

The increasing rates of gibberellin application significantly increased stem diameter from 1.21 mm to 1.37 mm. The control had the least diameter of 0.99 mm but comparable with those seedlings applied with 50 ppm GA_3. Both factors' interaction effects revealed that seedlings grown in garden soil + vermicast applied with 100 ppm gibberellins developed the largest stem diameter of 1.60 mm.

Means within the same columns and row followed by a common letter are not significantly different at 5% level DMRT.

Results indicate that growing media and gibberellins application rates significantly affected rubber seedlings' stem diameter 45 days after sowing. However, no significant interaction effects were observed. Rubber seedlings were grown in garden soil, plus vermicast resulted in the biggest stems with 1.85 mm. This was followed by 1.56 mm (garden soil mixed with chicken dung) and 1.25 mm (garden soil plus rice hull which were statistically similar. The control exhibited the smallest stems, which measured an average of 1.43 mm. Moreover, increasing application of gibberellins also resulted in a bigger seedling diameter of 1.69 mm (100 ppm), 1.61 mm (50 ppm), and 1.47 mm (0 ppm). However, the two factors failed to show significant effects on this parameter.

At 60 *Days after Planting (DAS)*

Statistical analysis revealed significant differences in rubber seedlings' stem diameter at 60 DAS as influenced by growing media. Seedlings in garden soil plus vermicast still exhibited the biggest diameter of 2.80 mm. Those grown in garden soil mixed with rice hull and chicken dung resulted in statistically comparable values of 2.68 mm and 2.65 mm, respectively. The control had the smallest stem diameter of 2.35 mm.

The gibberellins' application failed to influence this parameter. The stem diameter of rubber seedlings ranged from 2.58 mm to 2.65 mm. Moreover, the stem diameter of rubber seedlings was not affected by the interaction of these two factors.

Table 3: Stem diameter (mm) of rubber seedlings as influenced by growing media and rates of gibberellin

Treatments	Stem Diameter (cm)		
	30 DAS	**45 DAS**	**60 DAS**
Growing Media (A)			
Garden Soil (A_1)	1.18^{cd}	1.43^{c}	2.35^{c}
Garden Soil + Chicken Dung (A_2)	1.15^{c}	1.56^{b}	2.67^{b}
Garden Soil + Rice Hull (A_3)	1.25^{b}	1.52^{b}	2.68^{b}
Garden Soil + Vermicast (A_4)	1.35^{a}	1.85^{a}	2.80^{a}
F-Test	**	**	**
Rate of Gibberellins			
0 ppm (B_1)	0.99^{c}	1.47^{c}	2.58
50 ppm (B_2)	1.21^{bc}	1.61^{b}	2.62
100 ppm (B_3)	1.37^{a}	1.69^{a}	2.65
F-Test	**	**	ns
A x B			
A_1B_1	0.78^{c}	1.28	2.23
A_1B_2	1.08^{d}	1.48	2.37
A_1B_3	1.18^{cd}	1.53	2.46
A_2B_1	0.09^{c}	1.43	2.59
A_2B_2	1.21^{bcd}	1.57	2.65
A_2B_3	1.33^{b}	1.67	2.70
A_3B_1	1.21^{d}	1.41	2.66
A_3B_2	1.28^{bc}	1.50	2.66
A_3B_3	1.35^{b}	1.64	2.70
A_4B_1	1.18^{cd}	1.76	2.85
A_4B_2	1.31^{bc}	1.89	2.80
A_4B_3	1.60^{a}	1.92	2.75
F-Test	*	ns	ns
CV	6.53%	4.34	3.78

Height of seedlings

The height of rubber seedlings at 30, 45, and 60 DAS is presented in Table 4. The growing media and rates of GA_3 application and their interaction highly affected the height of rubber seedlings.

At 30 DAS

Rubber seedlings grown in garden soil in combination with vermicast were tallest (31.17 cm) compared to those in garden soil mixed with chicken dung (29.39 cm) and seedlings in garden soil with rice hull (27.64 cm). The shortest seedlings were obtained from those planted in pure garden soil (25.07 cm). Application of 100 ppm of GA_3 on rubber seedlings developed the tallest plants (40.94 cm), which differed significantly from those applied with 50 ppm with 39.34 cm. The shortest was recorded from those untreated with only 25.07cm.

At 45 DAS

At 45 DAS, seedlings growing in garden soil mixed with vermicast had (41.98 cm) height comparable to those in media consisting of chicken dung + garden soil with 40.77 cm height. Those sown in garden soil combined with rice hull had a height of 38.28 cm while the control (garden soil) had the shortest seedlings with 31.38 cm, only.

Table 4: Plant height (cm) of rubber seedlings at 30, 45, and 60 DAS in response to growing media and rates of gibberellin

Treatments	Plant Height (cm)		
	30 DAS	**45 DAS**	**60 DAS**
Growing Media (A)			
Garden Soil (A_1)	22.25^d	31.39^c	46.86^c
Garden Soil + Chicken Dung (A_2)	29.39^b	40.77^a	57.37^{ab}
Garden Soil + Rice Hull (A_3)	27.64^c	38.28^b	55.62^b
Garden Soil + Vermicast (A_4)	31.17^a	41.97^a	59.94^a
F-Test	**	**	**
Rates of Gibberellins			
0 ppm (B_1)	25.07^c	34.02^b	51.61^b
50 ppm (B_2)	28.04^b	39.34^b	53.59^b
100 ppm (B_3)	29.73^a	40.94^a	59.64^a
F-Test	**	**	**
A x B			
A_1B_1	20.67	28.60	42.67
A_1B_2	21.33	32.20	45.50
A_1B_3	24.77	33.37	52.40
A_2B_1	26.33	35.67	54.21
A_2B_2	30.17	42.17	56.43
A_2B_3	31.67	44.47	61.47
A_3B_1	25.60	34.33	53.03
A_3B_2	28.33	39.67	53.17
A_3B_3	29.00	40.83	60.67
A_4B_1	27.67	37.17	56.63
A_4B_2	32.33	43.33	59.25
A_4B_3	33.50	45.10	64.03
F-Test	ns	ns	ns
CV	5.54%	4.61%	5.16%

The same columns and rows followed by a common letter are not significantly different at the 5% level based on DMRT.

At 60 DAS

At 60 days after sowing, the tallest seedlings were found from garden soil - (59.94 cm) media mixture. These seedlings were comparable to those germinated in garden soil mixed with chicken dung and rice hull, which developed mean heights of 57.37 cm, and 55.62 cm, respectively. The shortest rubber seedlings were found in garden soil alone, which measured 46.67 cm tall

Rubber seedlings applied with 100 ppm GA_3 significantly exhibited the tallest plants (59.64), which differed from those applied with GA_3 50 ppm (53.58 cm). However, this treatment was statistically comparable with the control (51.61 cm). Although there were no significant interaction effects between these two factors, it was observed that rubber seedlings were grown in garden soil plus vermicast applied with GA_3 at 100 ppm markedly developed the tallest plants with an average of 64.03 cm.

Number of leaves

Table 5: Number of leaves per rubber seedling at 60 days DAS in response to growing media and rates of gibberellin

Growing Media	Rates of Gibberellin (ppm)			Mean**
	0	50	100	
Garden Soil	10.00	10.23	11.13	10.45[c]
Garden Soil + Chicken Dung	11.23	11.63	12.39	11.75[b]
Garden Soil + Rice Hull	11.67	11.67	11.72	11.68[b]
Garden Soil + Vermicast	12.87	12.72	12.98	12.85[a]
Mean*	11.44[b]	11.56[b]	12.05[a]	

Note: CV = 4.51%

Means within the same column and row followed by a common letter are not significantly different at 5% level DMRT.

The number of leaves of rubber seedlings at 60 DAS as affected by growing media and gibberellic acid is presented in Table 5. Analysis of variance on this parameter showed that the growing media and gibberellic acid rates significantly affected the number of leaves per rubber seedlings. Still, no significant interactions were observed between these two factors. Seeds sown in garden soil + vermicast produced the most number of leaves (12.86 per seedling), significantly varying from other treatments.

Rubber seedlings grown in garden soil combined with either chicken dung or rice hulls developed a more or less uniform number of leaves statistically comparable with each other with 11.68 to 11.75, respectively. The least number of leaves (10.45 leaves per seedling) was found in seedlings grown in garden soil (control).

Application of gibberellic acid at 100 ppm significantly induced the formation of the most number of leaves (12.05/seedling), which differed from those tested at the rate of 50 ppm with 11.56 seedling statistically comparable with the control with only 11.44 leaves.

However, no interaction effects were observed. Seeds are grown in garden soil + vermicast treated with 100 ppm GA_3 relatively developed the most 12.98 leaves per seedling.

Number of roots per seedling

Table 6: Number of roots per rubber seedling at 60 DAS as influenced by growing media and rates of gibberellin

Growing Media	Rates Of Gibberellin (ppm)			Mean**
	0	50	100	
Garden Soil	7.57	8.21	8.93	8.23[c]
Garden Soil + Chicken Dung	8.33	10.02	10.23	9.53[b]
Garden Soil + Rice Hull	9.67	11.11	11.88	10.89[a]
Garden Soil + Vermicast	9.55	10.50	11.33	10.46[a]
Mean**	8.78[b]	9.96[a]	10.59[a]	

Note: CV = 7.97%

Means within the same column and row followed by a common letter are not significantly different at 5% level DMRT.

The number of roots per seedling in response to growing media and gibberellin levels is given in Table 6. The number of roots per seedling was highly influenced by the growing media and levels of GA_3; however, no significant interaction effects were observed between these two factors.

Among the growing media, seedlings were grown in garden soil mixed with rice hull statistically exhibited the most number of roots (10.89), followed by garden soil plus vermicast (10.46) and garden soil combined with chicken dung (9.52). The values mentioned above were statistically higher by 15.8% to 32.32% than those in pure garden soil (control), which has only an average of 8.23 per plant.

The use of GA_3 treatment had increased the number of roots per seedling, regardless of growing media. Application of gibberellic acid at 50 and 100 ppm resulted in a statistically similar number of roots with an average of 9.96 to 10.59 per plant, respectively, which were significantly higher from the control (8.78). Although interaction effects of these two factors were not statistically significant, it was found that most growing media except 'garden soil' markedly produced more roots (10.89 per seedling) regardless of the rates of gibberellins used.

Length of roots per seedling

Table 7 presents the average length of roots per seedling in response to growing media and gibberellin rates. This parameter was highly influenced by the growing media and rates of gibberellic acid. However, the interaction effects of both factors on this parameter were not significant. Rubber seedlings in the different growing media showed that garden soil combined with vermicast developed the longest roots with a mean length of 8.32 cm, which significantly differed from the rest of the germinating media. The garden soil mixed with rice hull had an average length of roots of 7.63 cm, followed by seeds sown in garden soil plus chicken dung, which produced 7.30 cm length of roots per plant. While seedlings grown in garden soil as control significantly varied from these four treatments, which has only 6.54 cm length of roots.

The length of rubber seedlings length in response to different gibberellic acid concentrations exhibited significant effects of the different rates of GA3 used. The longest roots per rubber seedling were obtained at higher levels, specifically at 100 ppm with an average length of 7.69 cm, which statistically differed from the rest of the treatments. The two levels of treatments 0 ppm to 50 ppm have a comparable length of roots, which developed the shortest length of roots with an average of 7.25 to 7.40, respectively.

Table 7: Length (cm) of roots per rubber seedling at 60 DAS as influenced by growing media and rates of gibberellin

Growing Media	Rates Of Gibberellin (ppm)			Mean**
	0	50	100	
Garden Soil	6.39	6.44	6.79	6.54[d]
Garden Soil + Chicken Dung	7.06	7.27	7.58	7.31[c]
Garden Soil + Rice Hull	7.45	7.50	7.95	7.63[b]
Garden Soil + Vermicast	8.11	8.40	8.45	8.32[a]
Mean*	7.25[b]	7.40[b]	7.69[a]	

Note: CV = 4.39%

Means within the same column and row followed by a common letter are not significantly different at 5% level DMRT.

CONCLUSIONS

Based on the results, these conclusions are drawn:

The combination of garden soil and vermicast in equal proportion as growing media and applying gibberellic acid at 100 ppm on rubber seeds enhance early germination, high percentage germination, and produced more number of leaves, exhibit stem diameter with more number and longest roots of rubber seedlings.

RECOMMENDATIONS

Based on the foregoing findings of this study, the following recommendations are made:

1. Rubber seeds should be grown on garden soil with vermicast mixture as growing media; and
2. Application of gibberellic acid at 100 ppm to enhance early and high percentage germination produced more leaves, big stem diameter, and more number and longest roots of rubber seedlings.

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